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**BIOLOGY OF PUGET SOUND MARINE MAMMALS AND MARINE BIRDS:
POPULATION HEALTH AND EVIDENCE OF POLLUTION EFFECTS**

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EXECUTIVE SUMMARY

The objective of this research was to determine whether detrimental effects possibly caused by toxic chemicals could be observed in Puget Sound marine mammals and marine birds. The study design was based on examination of a wide variety of indices of population and individual health and comparison of these indices from areas of suspected high contaminant levels (target areas) to those from areas of suspected low contaminant levels (reference areas) and to those reported by other researchers.

Recent research conducted in Puget Sound has revealed high levels of contaminants in fish, marine mammals, and marine birds. High contaminant levels in Puget Sound have been correlated to abnormalities and disorders in fish. Researchers have also reported correlations between contaminants and disorders in marine mammals and marine birds in other parts of the world.

Primary species considered here are harbor seal, Glaucous-winged Gull, Great Blue Heron, and Pigeon Guillemot; these species were chosen because they reside, feed, and breed in some of the most contaminated portions of Puget Sound. Three other mammal species (killer whale, harbor porpoise, and river otter) were chosen as secondary study species either because they seasonally occur in contaminated areas of Puget Sound or they were found through previous research to be experiencing problems that might be pollutant-related.

Target areas were chosen that were as close as possible to the heavily contaminated Elliott and Commencement Bays. Reference areas used for different species included sites north of Puget Sound, in the Hood Canal, and in Grays Harbor and Willapa Bay on the Washington outer coast.

Several biological parameters were examined to evaluate the evidence for pollutant-related problems. These parameters included population distribution, population trends, measures of reproductive success, mortality, causes of death, incidence of gross and histological pathology, and incidence of physical deformities or disorders seen in the population. To detect a broad range of possible effects, both general population health as well as incidence of individual disorders previously linked to contaminants were examined and measured.

Study methods varied by species. Censuses were made from the ground, boats, and from small aircraft and provided population figures for several species. Reproductive rates were determined from censuses and for birds, by observing marked nests. Mortality and the incidence of reproductive disorders were determined from breeding area searches and censuses made during the breeding season. Gross pathology was determined from necropsies of animals found dead and for some species from collected individuals. Samples for histopathology, microbiology, blood parameters, and eggshell thickness were collected from appropriate species and examined by specialists for comparison between locations.

Tissues for contaminant analysis were collected and archived, but not analyzed.

We found a wide variety of disorders in some marine mammal and marine bird species. Some of these disorders followed patterns consistent with known patterns of contaminant concentrations in Puget Sound.

Overall, populations of the study species are doing very well, with the exception of the harbor porpoise and the killer whale; these two populations have declined in the Puget Sound area. For harbor porpoise the decline occurred prior to the 1970s and for killer whales the evidence of a decline is recent.

Harbor seal numbers are generally increasing in all our study areas, however, an unusually high incidence of premature births and neonatal mortality was found at some sites. These disorders are similar to those that have been linked to effects of contaminants in pinnipeds from other parts of the world. The high incidence of these disorders seen in Puget Sound seals, however, was found not at sites with suspected high contaminant levels but, rather unexpectedly, at study sites with suspected low contaminant levels. The most likely explanation for these problems is disease agents in these populations compounded by the possibility that these areas are nearing carrying capacity for seal numbers. A significantly higher incidence of pelage disorders and umbilical lesions

seen in contaminated areas shows a pattern that suggests a relationship with contaminants.

Puget Sound marine bird populations do not appear to be declining or experiencing major reproductive problems. Two of three primary study species (Glaucous-winged Gull and Great Blue Heron), however, did show significant eggshell thinning compared to pre-1947 measurements. In addition, Pigeon Guillemots had lower overall eggshell thickness than those reported for pre-1947, but the difference was not statistically significant. These findings suggest a possible persistent detrimental effect of the pesticide DDT (and its primary metabolite, DDE) as has been reported for a wide variety of bird species in other areas. We also found evidence of highly variable liver weights in gulls that may have been associated with contaminants. No conclusive statements regarding the association between contaminants and eggshell thinning or liver weights can be made until chemical analyses of archived tissues are conducted.

Contaminant analysis of archived samples would greatly augment this study in several ways. This analysis is important in order to: 1) verify our assumptions about contaminant exposure of different populations; 2) provide a better comparison with findings in other areas; 3) allow correlation tests between disorders found in specific animals and their contaminant burdens; and 4) describe trends in recent contaminant exposure of marine mammals and marine birds.